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Hermann Dick, Egbert Gerken, Thomas Mayer and David Vincent*

1. Introduction

A number of recent studies have shown that the short term level of economic activity and employment in primary commodity exporting countries is particularly vulnerable to price fluctuations in world commodity markets.[1] The authorities in such countries, in seeking to maintain output and employment stability, must invoke compensatory macroeconomic adjustment strategies to accommodate both favourable and unfavourable movements in the foreign terms of trade.

Chile provides a case in point. Chile has traditionally been heavily reliant on raw materials exports, particularly copper, for its foreign exchange earnings. Copper exports averaged around 70 per cent of total export earnings for the period 1960-1976. They currently represent about one half of total foreign exchange earnings.

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[1] See for example Dick et al (1982), Priovolos (1981), Lasaga (1981), Nziramasanga and Obidegwu (1981).

Since 1973 the Chilean economy has undergone an extensive transformation. Trade liberalisation[1], the elimination of controls on both product and factor prices, and the transfer of public sector enterprises to the private sector have been the main elements of the transformation (see Douglas (1981)). Coincident with the introduction of these changes has been the pursuit, by the economic authorities, of balanced domestic budgets and monetary restraint. Until recently the effects of these profound changes in the structure of the economy and the macroeconomic environment in which it operated have been readily apparent, at least with respect to non inflationary growth.[2]

However, as a consequence of this opening up of the economy to world trade and its still basic reliance on copper exports for its foreign exchange earnings, the extent of exposure of Chilean domestic activity and employment to world copper price movements has increased. Recent events in the world copper market and in the Chilean economy bear testimony to this fact. By November 1981 the world price of copper, denoted in US dollars,

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[1] This included the removal of quantitative restrictions on imports of all commodities except automobiles and a reduction in import tariffs from an average nominal rate of 105 per cent in 1973 to a flat nominal rate of 10 per cent in 1979.

[2] The annual growth in real GDP ranged from 4.5 per cent in the 1960-70 period, 1.3 per cent in the 1971-73 period to 8.2 per cent in the 1977-80 period. The annual change in the consumer price index increased from an average of 26 per cent in the 1960-70 period to more than 500 per cent in 1973. It was then reduced to 29 per cent in 1980 and 10 per cent in 1981. Unemployment averaged 6 per cent of the workforce in the 1960-70 and 4 per cent between 1971-73. It reached 15 per cent in 1976 before declining to 12 per cent in 1980-81.

on the London Metals exchange had fallen by 25 per cent from its average level of 1980. Since over this period the monetary authorities in Chile maintained a fixed parity between the Chilean peso and the US dollar, the f.o.b. export price in Chilean pesos fell by approximately the same amount. A price decline of this magnitude is equivalent, ceteris paribus, to a short run GDP decline of about 3 per cent. This shock is currently working its way through the Chilean economy. Its immediate legacies include an abrupt decline in real GDP growth from the rate achieved until the end of 1980, increased unemployment, and a sharp deterioration in the balance of trade.

The particular severity of the post 1980 economic depression has stimulated much debate about the appropriate policy mix to restore macroeconomic stability in the face of the slump in world copper prices. In this paper we consider a range of potential stabilisation policies for the Chilean economy. Using a multisectoral general equilibrium model we check the ability of alternative policy instruments to reach employment and current account targets while quantifying their implications for domestic prices, real GDP and other macroeconomic and structural variables which are of interest to policy makers. Each of the policy alternatives is efficient to some degree in meeting certain policy objectives while violating others. Thus the authorities are invariably confronted with a set of trade offs in choosing the most appropriate mix of policies. Our quantitative analysis seeks to make these trade offs explicit.

The plan of our paper is as follows. Section 2 discusses the policy options. Section 3 outlines the quantitative framework which is documented in detail in an Appendix. The macroeconomic and sectoral implications of the policy alternatives are presented in Section 4. Section 5 contains conclusions.

2. Stabilisation Policy Alternatives

We assume that the external shock to which the Chilean economy must adjust is the 25 per cent decline in world copper prices which took place over 1981. The stabilisation problem for our purposes then becomes one of facilitating the adjustment of the economy to "accommodate" the shock, which in this context means returning the economy to its position, primarily with respect to aggregate employment and the balance of trade, which existed before the slump in world copper prices. We classify the range of conventional policy options available to the authorities into two broad types: (a) those whose point of impact is on domestic macroeconomic variables and (b), those whose point of impact is on trade flows. The two types are of course interrelated. Policies which operate initially on macroeconomic variables will have implications for trade flows and vice versa. Nevertheless, we find the dichotomy a useful one.[1]

a. Domestic Macroeconomic Policies

Under this heading we consider four options:

[1] We do not take into account other shocks which have affected the Chilean economy in recent years. For example, pegging the Chilean peso to the US dollar despite substantial inflationary differences and of a worldwide appreciation of the dollar severely hampered the competitiveness of domestic industries. Since our study seeks to explore stabilisation alternatives for primary exporting countries in general we refrain from a simultaneous study of both the copper price shock and the exchange rate shock. For a discussion of Chilean policy options under both shocks see Gerken and Voigt (1982).

(i) expansionary fiscal and monetary policies in order to maintain real domestic absorption, (ii) a wage cut in the presence of a maintained real domestic absorption, (iii) a cut in real domestic absorption with fixed wages, and (iv) reductions in both wages and real domestic absorption.

Under option (i) the authorities might for example expand the domestic component of the money supply[1] by a sufficient amount to maintain the aggregate level of real household consumption, private investment and government expenditure in the face of the decline in world copper prices. There would be no correction of the nominal exchange rate or of the money wage level. The economy would contract more or less in line with its reduced income from copper. The balance of trade would deteriorate and unemployment would increase. The maintenance of real domestic absorption need not however imply that the shares of the absorption accounted for by households, private investors and government remain constant. For example, if the authorities use the increase in domestic money to finance the public sector deficit government expenditure would increase at the expense of private consumption and investment expenditure. While this would lead to somewhat different sectoral effects through differences in the sectoral composition of each of the final demand categories the broader implications would be equivalent to the case where the three components of absorption were held fixed.

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[1] This would be necessary to compensate for the reduction in the foreign component of money associated with the deterioration in the balance of trade. With a constant domestic component of the money supply, desired money demand would exceed actual money supply and thus induce a cutback in real household consumption and hence domestic absorption.

Of course, option (i) would only be sensible if the decline in the foreign terms of trade could be considered temporary. If international reserves together with access to foreign capital (for example, compensatory financing) were sufficient,the economy could simply ride out the short term balance of trade deterioration.

Policy option (ii) involves, in an environment of constant real domestic absorption, a real wage cut just sufficient to meet the employment constraint. Whether the required fall in real wages to compensate for the aggregate employment contraction associated with the copper price decline is politically feasible is a separate issue. By quantifying this fall together with its implications for the sectoral distribution of output and the functional distribution of income our analysis provides some guidance in this area.

A wage cut sufficient to restore employment in an environment of constant real domestic absorption is unlikely to eliminate the balance of trade deficit caused by the copper price decline. The balance of trade constraint could be met simply by adopting a purely deflationary domestic monetary policy in an environment of constant money wages. This forms our option (iii) in which real domestic absorption is squeezed just sufficiently to eliminate the balance of trade deficit occasioned by the slump in world copper prices.

As is well known, an adverse foreign terms of trade shock will neither endanger the internal equilibrium of a country

when factor prices adjust to the diminished relative valuation of its exports nor will it endanger its external equilibrium when real absorption decreases in line with the reduced real factor income. The orthodox neoclassical solution then requires both deflationary monetary policies to reduce domestic expenditure and wage flexibility downwards to restore the previous employment level. This forms our option (iv), namely a real wage cut to meet the domestic employment constraint and a cut in real domestic absorption to meet the balance of trade constraint. At least in the short-run however markets may not be sufficiently flexible to ensure adjustment. With commodity and factor prices being rigid downwards, external equilibrium could still be reached by a devaluation of the nominal exchange rate together with a restrictive monetary policy. However, unemployment would persist because of the failure of real wages to adjust to the reduced marginal product of labour.

b. Trade Policies

Under this heading we consider three alternatives, a devaluation of the Chilean peso against the US-dollar (option (v)), an across the board increase in protection afforded domestic industries (option (vi)), and subsidies to export industries (option vii).

A devaluation is a traditional tool for restoring the balance of trade. To be successful it must bring about an increase in the price of traded relative to non-traded goods.

If the devaluation is not accompanied by fiscal and monetary restraint then the initial change in relative prices it causes will be eroded by domestic inflation. In short, a devaluation, to have real effects, must be capable of bringing about a reduction in the real returns to one of the economy's factors of production. We illustrate this by comparing the results from a devaluation (at constant money wages) with those from option (ii) in which money wages are adjusted at a constant nominal exchange rate. The comparison indicates that the real effects of the two options are equivalent once the devaluation and the nominal wage reduction have been scaled to represent the same real wage effect.

Protection is always a tempting strategy to help restore the balance of trade and sustain employment following a terms of trade induced economic depression.[1] The fact that protection imposes significant long run social costs by inducing a misallocation of resources is well known. Our concern here is with the question - how effective is an across the board increase in tariffs in improving the balance of trade and employment in the short run? Tariff increases raise the price of imports in the domestic market allowing some expansion in employment in import competing industries. However, this is only the beginning of the story. Higher domestic prices feed into production costs and the consumer price index. They may also generate money wage increases as workers strive to maintain their real wage. The inflationary boost to the economy

[1] This was the option chosen by Chile following the slump in its foreign exchange earnings, economic activity and employment occasioned by the decline in world commodity prices of the 1930's great depression.

weakens the internationally competitive position of export industries whose ability to pass on domestic cost increases is limited. Thus the effectiveness of increased protection in improving the balance of trade and in stimulating employment is questionable.

Export subsidies are a frequently used tool in developing countries. They are sometimes seen as being necessary to offset the cost disadvantages experienced by export industries due to tariffs on imported inputs and an overvalued exchange rate. They provide an additional means of improving the price-cost situation of export industries to that of exchange rate and wage changes. Our option (vii) involves uniform increases in the power of the subsidy[1] on export commodities to bring about an improvement in foreign exchange earnings sufficient to offset the effects of the world copper price decline.

3. Analytical Framework

We have constructed a disaggregated economy-wide model of the Chilean economy. This model, centred around an input-output system of accounts, allows for the inclusion of many types of commodity and factor flows, e.g., commodity inputs from domestic and imported sources to current production, capital creation, households, government and exports, and industry inputs of primary factors (labour by occupation, fixed capital, land).

[1] That is, one plus the ad valorem rate of export subsidy.

It thus allows us to trace, in some detail, the effects of the change in world copper prices on the pattern of domestic economic activity and the distributional consequences of alternative policy responses. The model is general equilibrium in character providing an integrated description of production possibilities and demand conditions in Chile by endogenising both commodity and factor prices and quantities. Its structure pays close attention to microeconomic theory.[1] As such it emphasises the role of relative prices and substitution prospects in explaining trade flows and the composition of domestic economic activity. This neoclassical flavour is particularly appropriate for Chile given the essentially open free market character of its economy.

The model equations, expressed in linear percentage change form (the form in which the model is solved) are listed in Table A1[2]. Model variables are defined in Table A2 and coefficients in Table A3. The equations may be divided into six groups.

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[1] Major behavioural postulates are; (i) producers choose their commodity and factor inputs to minimise production costs of a given output subject to three level constant returns to scale industry production functions. At the first level is the Leontief assumption of no substitution between input categories or between them and an aggregate of the primary factors. At the second level are CES functions describing substitution between domestic and imported sources of each input category and between the three primary factors (aggregate labour, fixed capital, land). At the third level are CES functions describing substitution between different occupations within the aggregate labour category. (ii) Households choose their inputs to maximise an additive nested utility function subject to an aggregate budget constraint. The nests of commodity categories contain CES functions describing substitution prospects in consumption between domestic and imported sources of each category.

[2] A mathematical derivation of this type of equation system is given in Dixon et al (1982).

a. Final Demands

The model describes final demands for domestic and imported commodities by households, capital creators, other domestic (mainly government) and foreign sources. Equation (1) indicates that households can substitute between domestic and imported sources of their consumption goods according to changes in the relative prices of these goods from the two sources. The extent of substitution, for a given relative price change, is governed by the size of the relevant substitution elasticity ($\sigma_i^{(3)}$). Equation (2) indicates that households can also substitute between different commodity categories within their consumption bundles, the extent of substitution being a function of the change in relative prices of the commodity categories and the cross-price elasticities between categories. Equation (3) indicates that producers of capital goods can switch their demands between domestic and imported sources of supply according to relative price changes between the two sources. Demands for imported and domestic commodities for other (mainly government) purposes are related to real consumption expenditure (equation (4)). Finally, equation (5) indicates that provision is made for Chilean exports to influence world commodity prices.

b. Industry Inputs

These are described by equations (6) - (9). They indicate that Chilean industries can substitute between domestic and imported sources of their intermediate inputs, between the primary

factors labour, fixed capital, land, and between different labour occupations in producing their outputs. The extent of substitution for a given change in relative prices is governed by the relevant substitution elasticities.

c. Zero Pure Profits Conditions

Since constant returns to scale production technology and competitive behaviour is assumed in the derivation of the structural equations profits can accrue only to factors of production. Equation (10) equates industry output prices to production costs (intermediate input costs from domestic and imported sources, occupational labour costs and fixed capital and land costs). Equation (11) equates the price of a unit of capital creation in each industry to its production costs. Note that capital creation does not directly involve primary factors. They enter indirectly via their content in intermediate inputs. Equation (12) equates the selling prices of imported commodities to the cost of importing (which is the domestic currency equivalent of the foreign currency price including the tariff). Equation (13) equates the revenue from exporting (right hand side) to the costs of doing so.

d. Market Clearing

These relationships are depicted by (14) to (17) which equate supply with demand for domestically produced commodities, occupational labour, fixed capital and land. Note that imports

are not added to domestic production in determining total supplies. This is because commodities from foreign and domestic sources are treated as being distinct commodities. Note also that (15) - (17) simply amount to saying that factor employment levels are satisfied. They do not necessarily impose full employment assumptions.

e. The Monetary Sector

We include a rather simple monetary sector in the model. The money supply (M2) is assumed to be determined by applying a constant multiplier to the monetary base. The latter is decomposed into a domestic component, i.e., credit to the private and public sectors, and an international component, i.e., international reserves. Demand for money is assumed to be a function of the domestic price level, gross domestic product and expected inflation.[1] Equation (18) equates the supply of money to its demand. Equation (18a) defines the foreign component of money. Note that (18) is included in recursive fashion with the rest of the model. Its purpose is merely to illustrate some likely implications for the domestic and foreign components of the money supply of changes in other model variables.

f. Miscellaneous Equations

The model includes a large group of equations which are

[1] Since interest rates in Chile have been fixed by the monetary authorities, the main opportunity cost of holding money is inflation.

mainly definitional in character. Their structure is for the most part self explanatory. Of these however, equations (23) - (25), which determine the allocation of investment across industries, require further comment.[1] They follow from the assumption that (a) investment takes one period to install,[2] (b) investors have an expected rate of return schedule from new investment which is downwards sloping and (c) aggregate investment is allocated across industries to equate expected rates of return.

g. Solving the Model

From Tables A1 and A2 we see that there are 4gh + 11g + 9h + rh + 2r + 15 equations in 4gh + 15g + 11h + rh + 3r + 21 variables. The model is first closed by assigning values to a selection of 4g + 2h + r + 6 variables. (The exogenous variable selection for each of the experiments reported in Section 4 is set out in Table A4). Solution values for the remaining variables are obtained by simple matrix methods.

4. Results

In Table 1 we summarise the short run[3] macroeconomic and sectoral implications of the 25 per cent decline in world copper

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[1] We adopt the allocation theory set out in Dixon et al (1982).

[2] Since the model is of a one period comparative-static nature, this means that endogenous investment in the model's solution period does not augment the economy's capital stock in that period.

[3] By short run we mean that industry capital stocks are fixed. Thus the period we have in mind does not exceed the gestation lag on new investment (which is endogenous).

prices and the various stabilisation policies considered to "neutralise" the shock. We restrict our presentation of results to some macro aggregates and to industry outputs, labour demands and exports and imports of the major traded categories.[1] It is important to emphasise that the model is not being used here to provide forecasts about the likely level of endogenous variables at a future date. It merely projects the changes in the levels of these variables due to the changes in exogenous variables.

Option (i): The maintenance of real domestic absorption, fixed money wages and a fixed exchange rate

The world copper price decline leads to a 3.5 per cent decline in GDP, which, with sustained real absorption, is entirely made up of the deficit on the trade balance. To hold real domestic absorption constant the domestic component of the money supply must increase considerably thereby inducing a run-down of foreign currency reserves and an enormous (76 per cent) decrease in the foreign component of money. The reduction in aggregate employment of 0.7 per cent together with a 0.2 per cent increase in real wages coming from a corresponding decrease in the domestic price level implies an increase in real labour income of 0.8 per cent despite a 3.5 per cent decline in real national income.

[1] A list of projections for all endogenous variables is available from the authors.

Table 1 Projections of the Effects of the Copper Price Shock and Alternative Stabilisation Measures[a]

Variable	Option (i) 25 per cent world copper price decline, fixed exchange rate, money wages and real domestic absorption	Option (ii) 0.55 per cent decline in money wages, fixed exchange rate and real domestic absorption	Option (iii) 25 per cent world copper price decline, fixed exchange rate, money wages and balance of trade	Option (iv) 25 per cent world copper price decline, fixed exchange rate, aggregate employment and balance of trade	Option (v) 12.17 per cent exchange rate devaluation, fixed real domestic absorption and money wages	Option (vi) 10 per cent increase in protection, fixed exchange rate, real domestic absorption and money wages	Option (vii) 10.64 per cent increase in export subsidy power, fixed exchange rate, real domestic absorption and money wages
Macroeconomic							
Aggregate real absorption[c]	O(EX)[b]	O(EX)	-4.57	-2.71	O(EX)	O(EX)	O(EX)
Real GDP	-3.45	0.35	-4.57	-2.71	3.45	-0.30	3.45
Aggregate labour demand	-0.71	0.71	-4.34	O(EX)	7.07	0.71	5.02
Aggregate exports (foreign currency value)	-12.54	1.00	-6.43	-4.90	9.89	-4.87	17.25
Aggregate imports (foreign currency value)	-0.57	-0.21	-6.43	-4.90	-2.08	-3.75	5.28
Balance of trade	-10710.60	1075.96	O(EX)	O(EX)	10710.60	-1026.46	10710.60
Money wage	O(EX)	-0.55	O(EX)	-4.94	O(EX)	O(EX)	O(EX)
Real wage[d]	0.17	-0.88(EX)	2.72	-1.91	-8.86	-2.33	-3.81
Consumer price index	-0.17	-0.33	-2.72	-3.03	8.86	2.33	3.81
Labour's share of income	2.91	-0.52	2.95	0.80	-5.24	-1.32	-2.24
Money (M2)	-10.62	0.73	-16.56	-11.24	19.31	1.42	14.26
Domestic component of money	48.86	-5.56	-31.69	-21.51	-32.23	2.84	-41.89
Foreign component of money	-75.73	7.61	0.0	0.0	75.73	-0.10	75.73
Sector Outputs							
1. Agriculture	0.02	0.15	0.12	0.67	1.47	-0.10	1.41
2. Copper mining	-4.54	0.16	-4.39	-3.80	1.62	-0.30	1.82
3. Crude oil extraction	-0.03	0.16	-0.23	0.48	1.57	0.51	0.11
4. Other mining	0.24	2.24	3.54	11.23	22.27	-3.45	25.14
5. Food processing	0.03	0.42	-0.51	1.41	4.17	-0.41	4.45
6. Light manufacturing (import competing)	0.25	0.67	-0.73	2.37	6.66	0.71	5.37
7. Light manufacturing (export oriented)	0.12	1.00	2.15	5.36	9.95	-1.72	11.60
8. Petroleum refining	-0.51	0.29	-2.94	-0.80	2.85	0.01	2.18
9. Heavy manufacturing	0.92	0.66	-0.74	2.60	6.57	6.09	-0.50
10. Services	-0.07	0.21	-3.04	-0.98	2.09	0.30	0.93

Table 1 continued Projections of the Effects of the Copper Price Shock and Alternative Stabilisation Measures [a]

Variable	Option (i) 25 per cent world copper price decline, fixed exchange rate, money wages and real domestic absorption	Option (ii) 0.54 per cent decline in money wages, fixed exchange rate and real domestic absorption	Option (iii) 25 per cent world copper price decline, fixed exchange rate, money wages and balance of trade	Option (iv) 25 per cent world copper price decline, fixed exchange rate, aggregate employment and balance of trade	Option (v) 12.17 per cent exchange rate devaluation, fixed real domestic absorption and money wages	Option (vi) 10 per cent increase in protection, fixed exchange rate, real domestic absorption and money wages	Option (vii) 10.64 per cent increase in export subsidy power, fixed exchange rate, real domestic absorption and money wages
Main Exports							
2. Copper mining	-5.15	0.14	-4.70	-4.35	1.32	-0.61	2.09
4. Other mining	0.56	4.02	8.27	21.32	39.99	-10.35	51.96
5. Food processing	1.01	5.44	36.62	44.14	54.11	-21.81	92.36
7. Light manufacturing (export oriented)	0.27	2.12	9.95	14.58	21.08	-7.91	30.53
Main Imports							
1. Agriculture	0.12	0.49	-1.97	0.85	4.86	-5.58	19.18
3. Crude oil	-0.55	0.29	-3.81	-1.34	2.83	-0.10	19.40
4. Other mining	-0.03	0.27	-2.45	-0.36	2.71	-0.91	8.14
6. Light manufacturing (import competing)	-0.49	-0.19	-5.57	-4.20	-1.85	-7.81	8.46
8. Petroleum refining	-0.39	-0.22	-7.04	-5.23	-2.20	2.43	3.84
9. Heavy manufacturing	-0.67	-0.26	-6.63	-5.27	-2.63	-4.46	2.05
Labour Demand							
1. Agriculture	0.07	0.66	0.51	2.99	6.55	-0.41	6.28
2. Copper mining	-12.10	0.44	-11.71	-10.13	4.29	-0.71	4.84
3. Crude oil extraction	-0.17	0.87	-1.30	2.71	8.74	2.84	6.17
4. Other mining	0.30	2.84	4.48	14.24	28.23	-4.46	31.86
5. Food processing	0.09	1.15	-1.40	3.85	11.43	-1.22	12.21
6. Light manufacturing (import competing)	0.51	1.36	-1.48	4.82	13.54	1.32	10.94
7. Light manufacturing (export oriented)	0.28	2.43	5.22	13.01	24.15	-4.16	28.19
8. Petroleum refining	-0.64	0.36	-3.70	-1.00	3.58	0.01	2.75
9. Heavy manufacturing	1.46	1.06	-1.18	4.15	10.49	9.64	-0.80
10. Services	-0.13	0.41	-6.00	-1.94	4.14	0.71	1.82

(a) All projections are in percentage changes with the exception of the balance of trade which has the units millions of peso's at the 1977 exchange rate with the US dollar.

(b) Denotes variable exogenously set to zero.

(c) The proportional composition of this absorption (between aggregate consumption, investment and government spending) is assumed constant.

(d) Calculated by deflating movements in money wages by movements in the model's consumer price index.

The sectoral results clearly indicate that a policy of maintaining the real value of domestic absorption in the face of the terms of trade decline is particularly successful in containing the adjustment pressures to the copper sector itself.[1] The export led contraction in copper output results in employment in the copper sector declining by 12 per cent. This sector however employs only 6 per cent of the economy's workforce which is the reason for the small aggregate employment decline. Perhaps the only other notable feature of the sectoral results is a modest (0.9 per cent) expansion in the output of Sector 9 (Heavy manufacturing). This sector is heavily import competing.[2] It enjoys a slight improvement in its domestic costs relative to the price of competing imports leading to some substitution by domestic users away from the imported to the domestic product.

Option (ii): The maintenance of real domestic absorption, exogenous employment, wage flexibility

The figures in column (ii) represent the effects of an economy-wide wage cut sufficient to increase aggregate employment by 0.71 per cent, i.e., the amount of the aggregate employment

[1] This sector has few backward and forward linkages with other domestic sectors.

[2] The degree to which a sector competes against imports is, according to the model, an increasing function of the base period import penetration of commodities classified to that sector and the elasticity of substitution between domestic and imported sources. Imports account for 60 per cent of the base period usage of commodities classified to the sector while the import-domestic substitution elasticity is 2.0.

loss from the copper price decline (see column (i)).[1] The required wage adjustment is quite small, amounting to a 0.55 per cent decline in money wages, which, after taking into account the deflationary effect on the domestic price level is equivalent to a 0.88 per cent decline in real wages. The slight improvement in the economy's international competitiveness stimulates an improvement in the balance of trade. However, with real absorption held constant this improvement (1076 million pesos) is a long way short of that required to eliminate the deficit of 10711 million pesos arising from the copper price decline. Real GDP remains 3.1 per cent below the level it would have reached had the copper price decline not occurred. Real returns to labour decline by 0.17 per cent implying a 0.52 per cent decline in the share of the economy's income accruing to labour.

At the sector level traded industries receive a boost to their international competitiveness. Exports of major export commodities expand, particularly those produced in industries

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[1] Note however that the sectoral distribution of employment differs markedly between options (i) and (ii). The copper price decline with fixed real absorption causes employment losses principally in the copper sector itself. A wage cut however favours employment in all sectors. Traded sectors receive a direct stimulus to output and employment through an improvement in their international competitiveness. Other sectors are stimulated indirectly via their sales linkages (in the provision of inputs) to traded sectors.

whose production technology is labour intensive,[1] and major competing imports contract as domestic import-competing industries are better placed to meet import competition. The distribution of sectoral labour demands follows closely the output change.[2]

Option (iii): Cutting real domestic absorption, fixed money wages

The figures in column (iii) represent the effects of the 25 per cent copper price decline in an economic environment of fixed money wages with the balance of trade constraint being met by the endogenous contraction of real domestic absorption. The results highlight the severe consequences of money wage inflexibility in the presence of a balance of trade constraint. This constraint can only be met by a sharp deflation of the domestic economy resulting in a contraction in real GDP of 4.6 per cent and in aggregate labour demand of 4.3 per cent. The domestic

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1 Industry 4 (Other mining) is the best example. This industry is particularly labour intensive with labour costs comprising 41 per cent of its total costs in the base period. It thus undergoes a substantial improvement in the ratio of its domestic costs relative to the world prices, in pesos, received for its product, leading to an export led output expansion. Note also that the heavily export oriented copper sector shows only a modest improvement in its exports and output. Although this sector is reasonably labour intensive (labour costs representing 21 per cent of total costs) its export expansion in turn causes a lowering of the foreign copper price. Chilean exports represent about 12 per cent of total world copper demands. In the model, the foreign demand elasticity facing these exports is 2.0.

2 Since industry specific capital and land are assumed fixed the ratio of the percentage change in industry output to the percentage change in industry labour demands is given only by the share of value added in that industry accounted for by the return to labour.

price deflationary effects of the economic contraction imply a 2.7 per cent increase in real wages with the share of the reduced national income accruing to labour increasing by about 3 per cent. With the foreign component of the money supply constant the domestic component has to fall by 32 per cent to deflate the domestic economy and meet reduced money demand.

At the sectoral level traded industries (with the exception of copper whose world price is falling sharply) receive a boost to their international competitiveness from the reduction in the economy's price level, leading to an expansion of exports and a contraction of imports. The sectoral distribution of the economy's industrial production and employment shifts heavily towards the non-copper traded sectors. Less traded sectors such as for example Services suffer particularly severe output and employment declines.

Option (iv): Reductions in both wages and real domestic absorption

These policy instruments taken together represent the orthodox neoclassical approach to achieving internal and external balance. We allow the model to determine the size of the wage and real absorption reductions to restore the Chilean economy to the position, with respect to aggregate employment and the balance of trade, existing before the change in world copper prices occurred. The results indicate that a cut in real domestic absorption of 2.7 per cent together with a cut in money wages of 4.9 per cent is required to hit these targets. The reduction of the domestic component of money indicates that the appropriate

instrument to achieve the cut in real domestic absorption is a pure deflationary monetary policy, i.e., a cut in money supply. This is then followed by a decline in the consumer price index of 3.03 per cent, implying (since the money exchange rate is held constant) a devaluation of the real exchange rate of the same amount. Thus the competitive position of the traded goods sector is improved sufficiently to restore external balance. The decline in real wages of 1.9 per cent simply reflects the reduced marginal product of Chilean labour at the lower foreign terms of trade. Labour's share of the reduced national income improves slightly. The industrial structure of the economy that emerges is biased towards traded industries (with the exception of course of the copper sector).

Option (v): An exchange rate devaluation with sustained real domestic absorption and money wages

As noted earlier for a devaluation to have permanent effects on the real economy it must impose a squeeze on the real return of one of the factors of production. Here we assume that factor to be labour. By holding money wages constant the real price of labour falls by the increase in the domestic price level caused by the devaluation and concurring monetary expansion. The model indicates that an x per cent devaluation, assuming constant absorption and real wages, simply increases all domestic prices and monetary quantities by x per cent while leaving all endo-

genous real variables unchanged.[1]

Since the main target of the devaluation instrument is the balance of trade the results in column (v) refer to the effects on endogenous variables of a devaluation just sufficient to eliminate the balance of trade deficit which arose from the 25 per cent world copper price decline in the macroeconomic environment of option (i). The required devaluation turns out to be 12.17 per cent. Since real absorption is also assumed constant this leads to an increase in real GDP of 3.45 per cent, the size of the GDP contraction in option (i).

The devaluation and the concurring monetary expansion cause the domestic price level to rise by 8.86 per cent causing a corresponding fall in the real wage. In fact, as can be seen from comparing results between options (ii) and (v), its success in correcting the trade imbalance is entirely due to

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[1] This result simply reflects the fact that our model, in common with most other applied general equilibrium models, is homogenous of degree zero with respect to changes in all prices (or the exchange rate). It concurs with theoretical reasoning which says that, once real money balances have adjusted to the initial increase in prices of domestic and imported goods caused by a devaluation, relative prices between traded and non-traded goods will have reverted to their original position such that the only impact of the devaluation is to increase domestic inflation.

this real wage reduction.[1] At the sectoral level, the pattern of adjustment is the same as in (ii) being driven by an improvement in the international competitiveness of the traded goods sector.

There is however a difference in the monetary policies necessary to accommodate the real effects in options (ii) and (v). This is associated with the difference both in targets followed and instruments used by the two respective policies. As the policy target in option (v) is to restore the balance of trade equilibrium, the foreign component of money has to increase, whereas the domestic component decreases (both by considerable amounts).This adjustment pattern reflects the fact that the potential increase in domestic demand due to the rise in employment must be neutralised in favour of an increase of exports. Total money rises by about 19 per cent (10 per cent

[1] By comparing the figures in options (ii) and (v) we see that the elasticity of all endogenous variables (with the exception of the domestic consumer price index) with respect to a given percentage change in real wages is identical to the elasticity of endogenous variables with respect to a devaluation producing the same percentage change in real wages. The interpretation of the result for the consumer price index variable requires some care. In both options (ii) and (v) foreign prices in foreign currency are held constant. In option (v), the 12.17 per cent devaluation (and hence equivalent increase in foreign prices in Chilean pesos) produces a real wage reduction of 8.86 per cent and an increase in the consumer price index of the same amount. The domestic price level relative to foreign prices in Chilean pesos therefore falls by 3.31 per cent. From option (ii) we see (after scaling all results by 10.06) that an 8.86 per cent reduction in real wages with a fixed exchange rate causes the domestic consumer price index to fall by 3.31 per cent. That is, the percentage change in the domestic price level relative to foreign prices expressed in Chilean currency is the same in both options.

in real terms) in order to accommodate the increased domestic economic activity (3.4 per cent of GDP).

Returning to option (ii) we see that while the pattern of money variable changes is the same (decrease in domestic component, increase in foreign component, overall increase in real and nominal terms) the magnitudes are not comparable. Consider for example a devaluation sufficient to generate the same employment effects (0.71 per cent increase) as the 0.88 per cent real wage reduction of option (ii). The required devaluation is 1.2 per cent.[1] Although real variables would change by the same amounts under the 1.2 per cent devaluation and 0.88 per cent real wage cut options the monetary changes to achieve this differ. Under the 1.2 per cent devaluation the domestic component of money falls by 3.2 per cent (5.6 per cent in option (ii)), the foreign component increases by 7.6 per cent (as in option (ii)) while total money increases by 1.9 per cent (0.7 per cent in option (ii)). These differences reflect the different sources of the increased international competitiveness conferred in both options (v) and (ii), a devaluation accompanied by increased inflation in option (v) compared with a cost deflation in option (ii).

Note that because of the heavy squeeze on real wages imposed by the devaluation aggregate labour demand increases by

[1] Since the model is linear in percentage changes this is arrived at simply by multiplying 12.17 x 0,88/8.86 per cent. The effects on model variables of a 1.2 per cent devaluation are obtained by multiplying the results in column (v) by 0.88/8.86 per cent.

7.07 per cent, considerably above the contraction of 0.71 per cent observed from the 25 per cent copper price decline in column (i). Hence the required devaluation to hit the balance of trade target while maintaining real domestic absorption could only be achieved if there was a pool of unemployed equal to 6.36 per cent of the labour force in the base period before the fall in world copper prices took place. If for example Chile was at full employment in the base period, that is with labour supply effectively constraining growth, then our results indicate that the maximum devaluation that could be undertaken is only 1.22 per cent. Note that this would improve the balance of trade by only 1075.6 million pesos, far short of the 10710.6 million pesos required to eliminate the balance of trade deficit. In other words, with supply constraints in the labour market, a real wage cut achieved either through a devaluation with fixed money wages or by a direct reduction in real wages cannot sufficiently improve the balance of trade with real domestic absorption simultaneously held constant. The real wage cuts must be accompanied by reductions in real absorption, of the magnitude indicated in option (iv).

On the other hand however, a devaluation, if accompanied by a sufficiently tight monetary policy, would be capable of bringing about the required improvement in the balance of trade without raising domestic inflation. We have simulated this option by allowing the model to determine the size of the devaluation

required to achieve the balance of trade target (an improvement of 10710.60 million pesos) while at the same time not increasing the domestic price level (consumer price index).[1] The results indicate that a 2.7 per cent devaluation needs to be accompanied by a 3.5 per cent decline in real domestic absorption to achieve this. However, with both money wages and the domestic price level fixed there can be no adjustment of the real wage level to compensate for the reduced labour marginal product. The result is a further increase in unemployment of 1.2 per cent to be added to that caused by the copper price decline.

Option (vi): Increased protection against imports

In an environment characterised by a binding current account restriction, inflexibility of nominal wages and objections to a currency devaluation, one possible reaction to the adverse foreign terms of trade decline is to increase protection. Column (vi) refers only to a 10 per cent across the board increase in the ad valorem rate of protection in each sector[2] with constant real domestic absorption and money wages. It does

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[1] In terms of the closure set out in option (v) of Table A4 this is achieved by making real absorption and the exchange rate endogenous and setting the consumer price index exogenous (to zero) and the balance of trade exogenous (to 10710.6).

[2] We take as our measure of the ad valorem rate of protection the ratio of import duties to the cif value of imports in each sector as given in the base period input-output data.

not include the copper price shock.[1] The results clearly indicate the futility of Chile reverting to increased protection as a means of improving its balance of trade. The tariff increases, by allowing import competing industries to increase their domestic selling prices, improve their competitive position against imports. In doing so however, they increase the economy's domestic cost structure thus worsening the competitiveness of export oriented sectors which for the most part, are unable to recoup these cost increases in the form of higher selling prices for their products. In fact, Chilean exports overall turn out to be more responsive to deteriorations in their domestic cost-world price situation than are Chilean imports to deteriorations in their domestic selling price relative to the (now increased) selling price of the domestic counterpart. Hence the foreign exchange lost from exports exceeds the foreign exchange saved from import substitution leading to a small decline in the balance of trade and aggregate output. Domestic activity and employment is simply redistributed from export oriented to import competing sectors. The increase in the domestic price level with constant money wages implies a fall in the real wage level. This is crucial in mitigating against the output losses of the sector and permitting a small increase in aggregate employment.

As the balance of trade moves into deficit, the foreign

[1] Since however the model is linear in percentage changes of the variables the results for both the copper price shock and the tariff shock in an environment of fixed money wages and fixed real domestic absorption are obtained simply by adding the results in column (i) and (vi). Thus for example a 25 per cent reduction in the world price of copper together with a 10 per cent across the board increase in protection is projected to cause real GDP to decline by 3.75 per cent.

component of money must decrease. The domestic component of money must increase such that money supply (in nominal terms) rises. This is necessary to accommodate the increase in consumer prices. Note that real money supply contracts reflecting the lower economic activity as indicated by the fall in GDP.

We have rerun option (vi) with money wages fully indexed to consumer price movements, i.e., constant real wages. Under this assumption the domestic inflationary effects of the protection increase are higher (consumer price index increase of 0.32 per cent). This leads to a larger deterioration in the balance of trade (-382.1 million pesos) and real GDP (-0.12 per cent). It is interesting to note that aggregate employment now declines by 0.11 per cent. That is, in the absence of real wage flexibility downwards, increased protection destroys more jobs than it creates, while worsening the balance of trade to a greater extent than in the fixed money wage option.

Option (vii): Export subsidies

The results in column (vii) refer to a uniform (10.64 per cent) increase in the power of the export subsidy for each export commodity (in an environment of constant real domestic absorption and constant money wages). The boost to exports from this increase is just sufficient to eliminate the balance of trade deficit arising from the copper price decline in the same macroeconomic environment (option (i)). However, the subsidies, by raising domestic prices of export commodities which are also

used in the domestic economy, increase domestic inflation. This has adverse effects for import competing industries which lose domestic market share to imports.

Apart from its bias towards export industries at the expense of import competing industries within the traded goods sector the export subsidy result has a number of similarities to the devaluation result. In particular, the increase in the domestic price level brings about a corresponding contraction in real wages allowing a big increase in aggregate labour demand considerably in excess of that required to compensate for the employment losses associated with the copper price decline. Nevertheless, because of the penalisation of import competing industries the domestic inflationary and employment creating effects of the export subsidy approach to meeting the balance of trade constraint are somewhat less than is the case with the devaluation approach.

5. Conclusions

Our analysis has quantified the implications for the Chilean macroeconomy, the commodity composition of trade and the sectoral distribution of output and employment of seven alternative policy responses to a 25 per cent decline in world copper prices. Option (i), the maintenance of fixed real domestic absorption and money wages, is effective in confining the adjustment pressures to the copper sector itself. However, the sharp de-

terioration in the balance of trade and the inability of workers released by the contracting copper sector to be reemployed elsewhere in the economy makes such a minimal adjustment response viable only if the terms of trade decline could be regarded as temporary. The economy must have sufficient access to foreign currency to sustain it until the foreign terms of trade improve. Option (ii) indicates that a money wage cut of only 0.6 per cent is sufficient to restore employment, but with fixed real domestic absorption makes negligible impact on the balance of trade deficit. Conversely, with no money wage flexibility, attempts to meet the balance of trade constraint by domestic deflation (option (iii)) require an extremely severe contraction in domestic activity and employment. Putting option (ii) and (iii) together indicates that the neoclassical policy package of a combined 1.9 per cent cut in real wages and 2.7 per cent reduction in real domestic absorption is sufficient to restore both aggregate employment and the balance of trade. Under this package, the share of the (albeit reduced) national income accruing to labour actually increases. To achieve this adjustment, employment must be transferred from the copper sector to other traded (particularly export oriented) industries.

Of the trade policies considered the real wage depressing effects of a devaluation sufficient to meet the balance of trade constraint with fixed real domestic absorption result in a demand for labour far in excess of that required to compensate for the copper price decline. The domestic inflationary effect of the devaluation is rather large. This raises the possibility

of a rekindling of inflationary expectations, dampened in Chile in recent years by deflationary domestic spending policies to support a relatively high fixed exchange rate. Our comparative static analysis makes no provision for the incorporation of the effects of such expectations. To avoid stimulating inflation, a devaluation in an environment of fixed money wages must be accompanied by a cut in real domestic absorption. The problem with this strategy however, is that because it rules out a reduction in real wages it cannot meet the employment target.

The export subsidy approach in an environment of fixed money wages and real domestic absorption also raises the domestic price level though to a lesser extent than with the devaluation. Because its real wage depressing effect is less it can achieve the balance of trade target with a lower overshooting on the employment target than is the case with a devaluation. However, the use of export subsidies on the scale required would run the risk of overseas retaliation (not incorporated in our analysis). Furthermore their cost to the authorities would amount to over 3 per cent of the 1977 level of government expenditure. In assuming their implementation in an environment of fixed real domestic absorption, our analysis abstracts from the macroeconomic implementation of financing these subsidies.

It is interesting to note that the protection option fails completely to improve the balance of trade. Its positive employment effects come only by its ability, by increasing

domestic prices in an environment of constant money wages, to bring about a reduction in real wages.

The inexorable impression from our analysis is the importance of wage flexibility downwards to compensate for the reduced marginal product of labour implied by the terms of trade decline. In the presence of labour supply constraints, wage flexiblity on its own is insufficient. It must be coupled with expenditure restraint to release resources from the domestic to the foreign account.

Table A1 The Chilean Model Equations: A Linear System in Percentage Changes[a]

Identifier	Equation[b][c]	Subscript Range	Number	Description
	1. Final Demands			
(1)	$x^{(3)}_{is} = x^{(3)}_{i} - \sigma^{(3)}_{i}(p_{is} - \sum_{s=1}^{2} S^{(3)}_{is}\, p_{is})$	i=1,...,g s=1,2	2g	Household demands for commodities by source
(2)	$x^{(3)}_{i} = q + \varepsilon_i(c - q) + \sum_{k=1}^{g} \eta_{ik}\, p_k$	i=1,...,g	g	Household demands for commodities undifferentiated by source
(3)	$x^{(2)}_{(is)j} = y_j - \sigma^{(2)}_{ij}(p_{is} - \sum_{s=1}^{2} S^{(2)}_{(is)j}\, p_{is})$	i=1,...,g s=1,2 j=1,...,h	2gh	Demands for inputs to capital creation
(4)	$x^{(5)}_{is} = c_R$	i=1,...,g s=1,2	2g	Other (mainly government) demands
(5)	$p^{e}_{i} = -\gamma_i\, x^{(4)}_{i1} + f^{(4)}_{i1}$	i=1,...,g	g	Export demands
	2. Industry Inputs			
(6)	$x^{(1)}_{(is)j} = z_j - \sigma^{(1)}_{ij}(p_{is} - \sum_{s=1}^{2} S^{(1)}_{(is)j}\, p_{is})$	i=1,...,g s=1,2 j=1,...,h	2gh	Demands for intermediate inputs
(7)	$x^{P}_{vj} = z_j - \sigma^{P}_{j}(p^{P}_{vj} - \sum_{v=2}^{3} S_{vj}\, p^{P}_{vj} - S_{1j}\, p^{P}_{1})$	v=2,3 j=1,...,h	2h	Demands for fixed capital (v=2) and land (v=3)
(8)	$x^{P}_{1j} = z_j - \sigma^{P}_{j}(p^{P}_{1} - \sum_{v=2}^{3} S_{vj}\, p^{P}_{vj} - S_{1j}\, p^{P}_{1})$	j=1,...,h	h	Demands for aggregate labour
(9)	$x^{P}_{1,q,j} = x^{P}_{1j} - \sigma^{P}_{1,j}(p^{P}_{1,q} - \sum_{q=1}^{r} S_{1,q,j}\, p^{P}_{1,q})$	q=1,...,r j=1,...,h	rh	Demands for labour of each occupation
	3. Zero Pure Profits Conditions			
(10)	$p_{j1} = \sum_{i=1}^{g}\sum_{s=1}^{2} H^{(1)}_{(is)j}\, p_{is} + \sum_{q=1}^{r} H^{P}_{1,q,j}\, p^{P}_{1,q} + \sum_{v=2}^{3} H^{P}_{vj}\, p^{P}_{vj}$	j=1,...,h	h	- in production
(11)	$\pi_j = \sum_{i=1}^{g}\sum_{s=1}^{2} H^{(2)}_{(is)j}\, p_{is}$	j=1,...,h	h	- in capital creation
(12)	$p_{i2} = p^{m}_{i2} + t_i + \phi$	i=1,...,h	g	- in importing
(13)	$p_{i1} = p^{e}_{i} + v_i + \phi$	i=1,...,g	g	- in exporting
	4. Market Clearing			Supply equals demand for
(14)	$z_j = \sum_{j=1}^{h} B^{(1)}_{(i1)j}\, x^{(1)}_{(i1)j} + \sum_{j=1}^{h} B^{(2)}_{(i1)j}\, x^{(2)}_{(i1)j} + B^{(3)}_{i1}x^{(3)}_{i1} + B^{(4)}_{i1}\, x^{(4)}_{i1} + B^{(5)}_{i1}\, x^{(5)}_{i1}$	j=1,...,g	g	- domestically produced commodities
(15)	$\ell_q = \sum_{j=1}^{h} B_{1,q,j}\, x^{P}_{1,q,j}$	q=1,...,r	r	- labour of each occupation
(16)	$k_j = x^{P}_{2j}$	j=1,...,h	h	- capital
(17)	$n_j = x^{P}_{3j}$	j=1,...,h	h	- land

Table A1 continued The Chilean Model Equations: A Linear System in Percentage Changes[a]

Identifier	Equation	Subscript Range	Number	Description
	5. Monetary Sector			
(18)	$S_d m_n^d + S_f m_n^f = \epsilon^{(3)} + \psi_3 gdp - \psi_4 w$		1	Supply equals demand for money
(18a)	$m^f_n = \psi_5 \Delta B$		1	Defines foreign reserves
	6. Miscellaneous			
(19)	$x_{i2} = \sum_{j=1}^{h} B^{(1)}_{(i2)j} x^{(1)}_{(i2)j} + \sum_{j=1}^{h} B^{(2)}_{(i2)j} x^{(2)}_{(i2)j}$ $B^{(3)}_{i2} x^{(3)}_{i2} + B^{(5)}_{i2} x^{(5)}_{i2}$	$i=1,\ldots,g$	g	Competitive import volume
(20)	$m = \sum_{i=1}^{g} (p^m_{i2} + x_{i2}) M_{i2}$		1	Foreign currency imports
(21)	$e = \sum_{i=1}^{g} (p^e_{i1} + x^{(4)}_{i1}) E_{i1}$		1	Foreign currency exports
(22)	$100\Delta B = Ee - Mm$		1	Balance of Trade
(23)	$r_j = Q_j (p^p_{2j} - \pi_j)$	$j=1,\ldots,h$	h	Rate of return to capital
(24)	$y_j = k_j + B_j (r_j - \lambda)$	$j=1,\ldots,h$	h	Industry investment
(25)	$\Sigma_j(\pi_j + y_j)T_j = i$		1	Investment budget
(26)	$p^p_1 = \sum_{q=1}^{r} p_{1,q} S_{1,q}$		1	Price of labour in general
(27)	$p_k = \sum_{s=1}^{2} S^{(3)}_{ks} p_{ks}$	$k=1,\ldots,g$	g	General price of goods to households
(28)	$\epsilon^{(3)} = \sum_{i=1}^{g} \sum_{s=1}^{2} W^{(3)}_{is} p_{is}$		1	Consumer price index
(29)	$\epsilon^{(2)} = \sum_{j=1}^{h} T_j \pi_j$		1	Capital goods price index
(30)	$c_R = c - \epsilon^{(3)}$		1	Aggregate real consumption
(31)	$i_R = i - \epsilon^{(2)}$		1	Aggregate real investment
(32)	$i_R - c_R = f_R$		1	Relationship between real consumption and investment
(33)	$\ell = \sum_{q=1}^{r} \ell_q \psi_{1q}$		1	Aggregate employment
(34)	$\kappa = \sum_{j=1}^{h} k_j \psi_{2j}$		1	Aggregate capital stock
(35)	$p^p_{1,q} = h_{1,q} \epsilon^{(3)} + f_{1,q} + f_1$	$q=1,\ldots,r$	r	Allows for exogenous setting of wages
(36)	$gdp = S_c c_r + S_i i_R + S_g \left[\sum_{s=1}^{2} \sum_{i=1}^{g} x^{(5)}_{is} S^{(5)}_{is}\right]$ $+ S_e e - S_m m$		1	Gross domestic product

Total equations = 4gh + 11g + 9h + rh + 2r + 15

(a) The variables and coefficients are defined in Tables A2 and A3.

(b) The model distinguishes 10 domestic industries each producing its respective commodity i.e., g and h = 10. Hence $p_{j1} = p_{i1}$, j = 1,...,h, i = 1,...,g. (Labels for these are given in Table 1). The labour market is divided into two occupational categories, i.e., r = 2. The superscript s denotes the source of the commodity, s = 1 (domestically produced), s = 2 (imported). The superscript v denotes the type of primary factor; v = 1 (aggregate labour), v = 2 (fixed capital), v = 3 (land).

(c) The nomenclature of variable superscripts is as follows. Superscript "P" denotes a primary factor quantity or price, superscript "m" a foreign price for imports (cif) and superscript "e" a foreign price for exports (fob). Superscript (1) denotes the use of that variable in current production, (2) in capital creation, (3) by households, (4) exports and (5) by other (mainly government) demands. Note that there is no superscript on the local prices of domestic and imported commodities (the p_{is}). That is, the price of a commodity is assumed to be the same in all domestic end uses.

Table A2 Chilean Model Variables

Variable[a]	Number	Description[b]
$x_{is}^{(3)}$	2g	Household demands for domestic and imported goods
$x_{i}^{(3)}$	g	Household demands for goods undifferentiated by source
p_{is}	2g	Price of good i from source s
q	1	Number of households
c	1	Aggregate money consumption
p_{k}	g	Price of consumer goods by type but not by source
$x_{(is)j}^{(2)}$	2gh	Demands for inputs (domestic and imported) for capital creation
y_{j}	h	Capital creation by using industry
$x_{is}^{(5)}$	2g	Other (mainly government) demands for domestic and imported goods
c_{R}	1	Aggregate real household expenditure
p_{i}^{e}	g	F.o.b. foreign currency export prices
$x_{i1}^{(4)}$	g	Export demands
$f_{i1}^{(4)}$	g	Export demand shift variable
$x_{(is)j}^{(1)}$	2gh	Demands for inputs (domestic and imported) for current production
z_{j}	h	Industry outputs
x_{vj}^{p}	3h	Industry demands for labour in general, fixed capital and land
p_{vj}^{p}	2h	Rental prices of capital (v=2) and land (v=3) in each industry
p_{1}^{p}	1	Economy wide price of labour in general
$x_{1,q,j}^{p}$	rh	Demands for labour by occupation and industry
$p_{1,q}^{p}$	r	Price of labour by occupation
π_{j}	h	Costs of units of capital
p_{i2}^{m}	g	C.i.f. foreign currency prices for competing imports
t_{i}	g	One plus the ad valorem rates of protection on imports
ϕ	1	Exchange rate (Chilean peso/foreign currency ($ US))
v_{i}	g	One plus ad valorem export subsidies
ℓ_{q}	r	Employment by occupation
k_{j}	h	Industry capital stocks
n_{j}	h	Industry land

Table A2 continued Chilean Model Variables

Variable[a]	Number	Description[b]
m_n^d	1	Domestic component of money
m_n^f	1	Foreign component of money
$\varepsilon^{(3)}$	1	Consumer price index
gdp	1	Gross domestic product
w	1	Expected inflation
ΔB	1	Balance of trade
x_{i2}	g	Commodity import volumes
m	1	Foreign currency value of imports
e	1	Foreign currency value of exports
r_j	h	Industry rates of return to capital
λ	1	Economy-wide expected rate of return
i	1	Aggregate nominal investment
$\varepsilon^{(2)}$	1	Investment goods price index
i_R	1	Aggregate real investment
f_R	1	Shift term to set relationship between aggregate consumption and investment
ℓ	1	Aggregate employment
κ	1	Economy's aggregate capital stock
$f_{1,q}$	r	Shift term for occupational wages
f_1	1	Economy-wide wage shift variable

Total variables: $4gh + 15g + 11h + rh + 3r + 21$

(a) The variable subscript range is as follows: $i,k = 1,\ldots,g$; $s = 1,2$; $v = 1,2,3$; $j = 1,\ldots,h$; $q = 1,\ldots r$.

(b) All variables are in percentage changes except the balance of trade, ΔB, which, because it can move through zero, is expressed in first differences.

Table A3 Coefficients of the Chilean Model

$\sigma_i^{(3)}$
$\sigma_{ij}^{(1)}$
$\sigma_{ij}^{(2)}$

CES import-domestic substitution elasticities for good i in household consumption ($\sigma_i^{(3)}$), intermediate usage in industry j for current production ($\sigma_{ij}^{(1)}$), and as inputs to capital creation ($\sigma_{ij}^{(2)}$). A common value of 2.0 was assigned to all these elasticities. This value, while judgemental, is consistent with estimates from the few published studies in this area.

σ_j^P
$\sigma_{1,j}^P$

CES substitution elasticities among primary factors (σ_j^P), and amongst occupational labour ($\sigma_{1,j}^P$) in industry j. Since relative wages between occupations were assumed fixed in all experiments the values assigned to $\sigma_{1,j}^P$ (1.0 for all j), exert no influence on the results. The following values for σ_j^P were used, 1. Agriculture (0.31), 2. Copper mining (0.20), 3. Crude oil extraction (0.51), 4. Other mining (0.51), 5. Food processing (1.0), 6. Light manufacturing (import competing) (1.0), 7. Light manufacturing (export oriented) (1.0), 8. Petroleum refining (1.0), 9. Heavy manufacturing (1.0), 10. Services (0.43). The values for sectors 1,3,4 and 10 were drawn from the econometric estimates in Behrman (1972). The value for sector 2 was set to reflect a short-run supply elasticity for copper production of 0.114, the supply elasticity reported in Lasaga (1981). Values for the remaining sectors are based on the estimates reported in Corbo and Meller (1979).

ε_i
η_{ik}

Expenditure (ε_i) and cross price (η_{ik} $i \neq k$) elasticities in household consumption for good i. Estimates for ε_i were obtained from the Chilean household demand studies reported in Lluch, Powell and Williams (1977) and Taborga (1978).The estimates used for each of the ten commodity groups are, 1. (0.60), 2. - 5. (0.75), 6. (1.10), 7. - 8. (1.41), 9. (1.62), 10. (1.18). Since the underlying household utility functions are assumed to be additive, the matrix of uncompensated own price (η_{ii}) and cross price (η_{ik}) consumer demand elasticities were obtained from

Table A3 continued Coefficients of the Chilean Model

$$\eta_{ii} = \frac{\varepsilon_i}{w} - \varepsilon_i \alpha_i \left(1 + \frac{\varepsilon_i}{w}\right)$$

$$\eta_{ik} = - \varepsilon_i \alpha_j \left(1 + \frac{\varepsilon_j}{w}\right) \qquad i \neq k$$

Where w is the Frisch parameter and α_j are household budget shares calculated from the 1977 input output table. The estimate of w (-2.525) was obtained using the relationship between per capita GDP and Frisch parameter values estimated by Lluch, Powell and Williams (1977).

γ_i Reciprocals of the foreign demand elasticities for Chilean export commodity i. For all commodity categories except copper, the "small country" assumption was approximated by assigning a large value (20.0) to the respective γ_i's. For copper, a value of 0.5 was used. This value is based principally on the world price elasticity of demand for copper and the Chilean share in world copper exports.

Q_j, B_j, T_j Industry investment parameters. Q_j is the ratio of the gross (before depreciation) to the net (after depreciation) rate of return in industry j. B_j is the reciprocal of the elasticity of the expected rate of return schedule for industry j times the ratio of its gross investment to its following year capital stock. T_j is the share of total investment accounted for by industry j. T_j was obtained from the 1977 Chilean input-output table. Q_j and B_j are judgemental.

ψ_{1q}, ψ_{2j} Respectively the share of aggregate employment accounted for by occupation q and the share of the economy's aggregate capital stock in industry j. The percentage share of skilled (52.2) and unskilled (47.8) workers was obtained from República de Chile, encuesta nacional del empleo. Values for ψ_{2j} were calculated by using information given in the 1977 Chilean input-output table.

Table A3 continued Coefficients of the Chilean Model

$h_{1,q}$	Indexes occupational wages to consumer price. The $h_{1,q}$ were set to zero in 1-5,7. For the second part of experiment 6, which concerns reductions in real wages, the $h_{1,q}$ were set to 1.0.
S_c, S_i, S_g, S_c, S_m	Respectively the shares of GDP accounted for by aggregate consumption, investment, other (mainly government) domestic, export and import demand. The shares, which sum to unity, were obtained from the 1977 Chilean input-output table.
$S^{(1)}_{(is)j}$, $S^{(2)}_{(is)j}$	Shares of good i from source s (domestic or imported) in industry j's purchases of i for current production (1), and capital creation (2). Obtained from the 1977 Chilean input- output table.
$S^{(3)}_{is}$	Share of the value of good i from source s in the total purchases of good i by households. Obtained from the 1977 Chilean input output table.
S_{vj}, $S_{1,q,j}$	Respectively the share of primary factor v in the total primary factor costs of industry j and the share of labour by occupation q in industry j's total labour costs. Obtained from the 1977 Chilean input-output table.
$H^{(1)}_{(is)j}$, $H^{P}_{1,q,j}$, H^{P}_{2j}, H^{P}_{3j}	Respectively the shares of industry j's production costs represented by intermediate inputs of good i from source s, labour inputs of occupation q,fixed capital,and land. Obtained from the 1977 Chilean input-output table.
$B^{(1)}_{(i1)j}$, $B^{(2)}_{(i1)j}$, $B^{(3)}_{i1}$, $B^{(4)}_{i1}$, $B^{(5)}_{i1}$	Respectively the share of the total sales of domestic good i absorbed by, inputs to industry j for current production (1), and for capital creation (2), by households (3),exports (4), and other (mainly government) demands (5). Obtained from the 1977 Chilean input-output table.

Table A3 continued Coefficients of the Chilean Model

$B^{(1)}_{(i2)j}$, $B^{(2)}_{(i2)j}$, $B^{(3)}_{(i2)}$, $B^{(5)}_{i2}$	Respectively the share of the total sales of imported good i absorbed by, inputs to industry j for current production (1) and for capital creation (2), by households (3), exports (4),and other (mainly government) demands (5). Obtained from the 1977 Chilean input-output table.
$B_{1,q,j}$, $S_{1,q}$	Share of the economy's employment of occupation q accounted for in industry j, and cost share of labour of type q in the economy's total labour cost respectively. Obtained from the 1977 Chilean input-output table.
$S^{(5)}_{is}$	Share of aggregate other demands accounted for by other demand for good i from source s. Obtained from the 1977 Chilean input-output table.
M_{i2}, E_{i1}, M, E	The share of total foreign currency costs accounted for by imported good i (M_{i2}), the share of total foreign currency export earnings accounted for by exported commodity i (E_{i1}), the aggregate foreign currency value of imports (M), and the aggregate foreign currency value of exports (E). Obtained from the 1977 Chilean input-output table.
$W^{(3)}_{is}$	Expenditure weight of good i from source s in the model's index of consumer prices. Obtained from the 1977 Chilean input-output table.
S_d, S_f	Respectively the shares of domestic and foreign component in total money supply. Obtained from IMF International Financial Statistics.
ψ_3, ψ_4, ψ_5	ψ_3 and ψ_4 are respectively the elasticities of the demand for money with respect to gross domestic product and expected inflation. An econometric study of these elasticities yielded values of 3.029 (ψ_3) and 0.155 (ψ_4). (See Fischer and Mayer (1981) for details). ψ_5 is the reciprocal of the base period reserve stocks. Obtained from IMF International Financial Statistics.

Table A4 Exogenous Variable Selection and Values for Each Experiment

(a) Variable	Number	Option (i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
k_j	h	0	0	0	0	0	0	0
n_j	h	0	0	0	0	0	0	0
q	1	0	0	0	0	0	0	0
$f^{(4)}_{i1}$ (i=1,3-10)	g	0	0	0	0	0	0	0
$f^{(4)}_{i1}$ (i=2)	g	-25	0	-25	-25	0	0	0
p^{m}_{i2}	g	0	0	0	0	0	0	0
t_i	g	0	0	0	0	0	$10(\tau_i/1+\tau_i)$ (c)	0
$x^{(4)}_{i1}$ i=3,8,9,10	(b) g	0	0	0	0	0	0	0
v_i i=1,2,4-7		0	0	0	0	0	0	10.64
$f_{1,q}$	r	0	0	0	0	0	0	0
w	1	0	0	0	0	0	0	0
ϕ	1	0	0	0	0	-12.17	0	0
c_R	1	0	0			0	0	0
i_R	1	0	0			0	0	0
f_R	1			0	0			
ΔB	1			0	0			
f_1	1	0	-0.55	0		0	0	0
ℓ	1				0			

Total exogenous variables = 4g + 2h + r + 6 for each experiment. These are made up of a common set of 4g + 2h + r + 3 variables which are exogenous in all experiments and a further selection of 3 variables.

(a) For variables labels see Table A2.

(b) We allow the model to explain exports for the major export commodities, i.e., those whose sales pattern is such that their domestic prices can be regarded as being set by their corresponding world prices. For other commodities, exports are determined exogenously with the model endogenising the corresponding export subsidy/tax variable. (Note from (13) that if v_i is exogenous then p_{i1} will tend to move with p^e_i. If v_i is endogenous then p_{i1} will move independently of p^e_i).

(c) To achieve a 10 per cent increase in the ad valorem rate of protection for commodity i we need to increase the model variable representing the percentage change in one plus the ad valorem rate of protection, i.e., t_i, by $10(\tau_i/1+\tau_i)$ per cent, where τ_i is the base period ad valorem rate of protection for commodity i.

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